GLAST Large Area Telescope
Calorimeter Subsystem

Thermal-Vacuum Test

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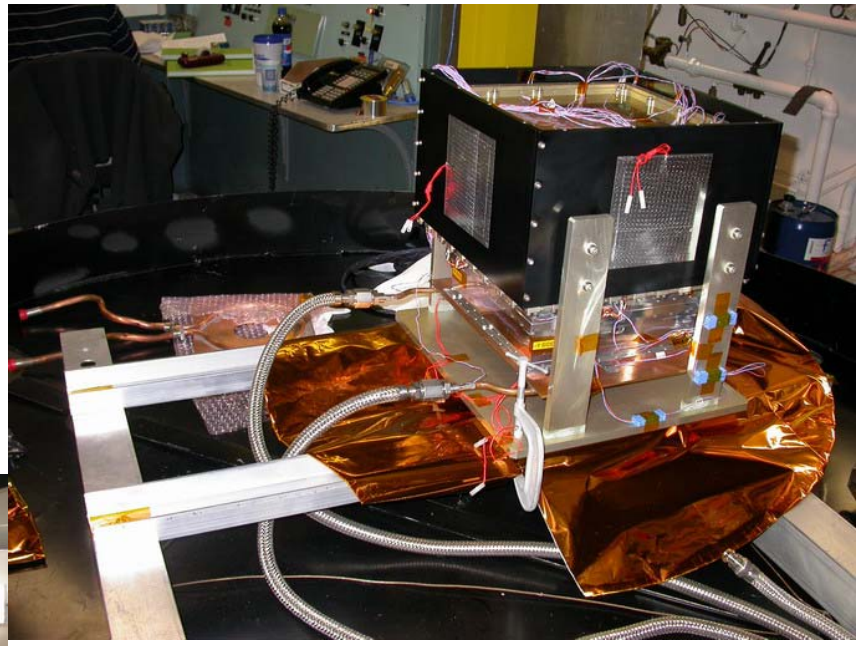
Naval Research Lab
Washington DC

Thermal-Vacuum Testing

EM CAL in GRID environment simulator with heaters and cold plates

April 2003



EM CAL inside thermal shroud mounted to NRL's South Thermal Vacuum Chamber

April 2003

Naval Research Lab
Washington DC

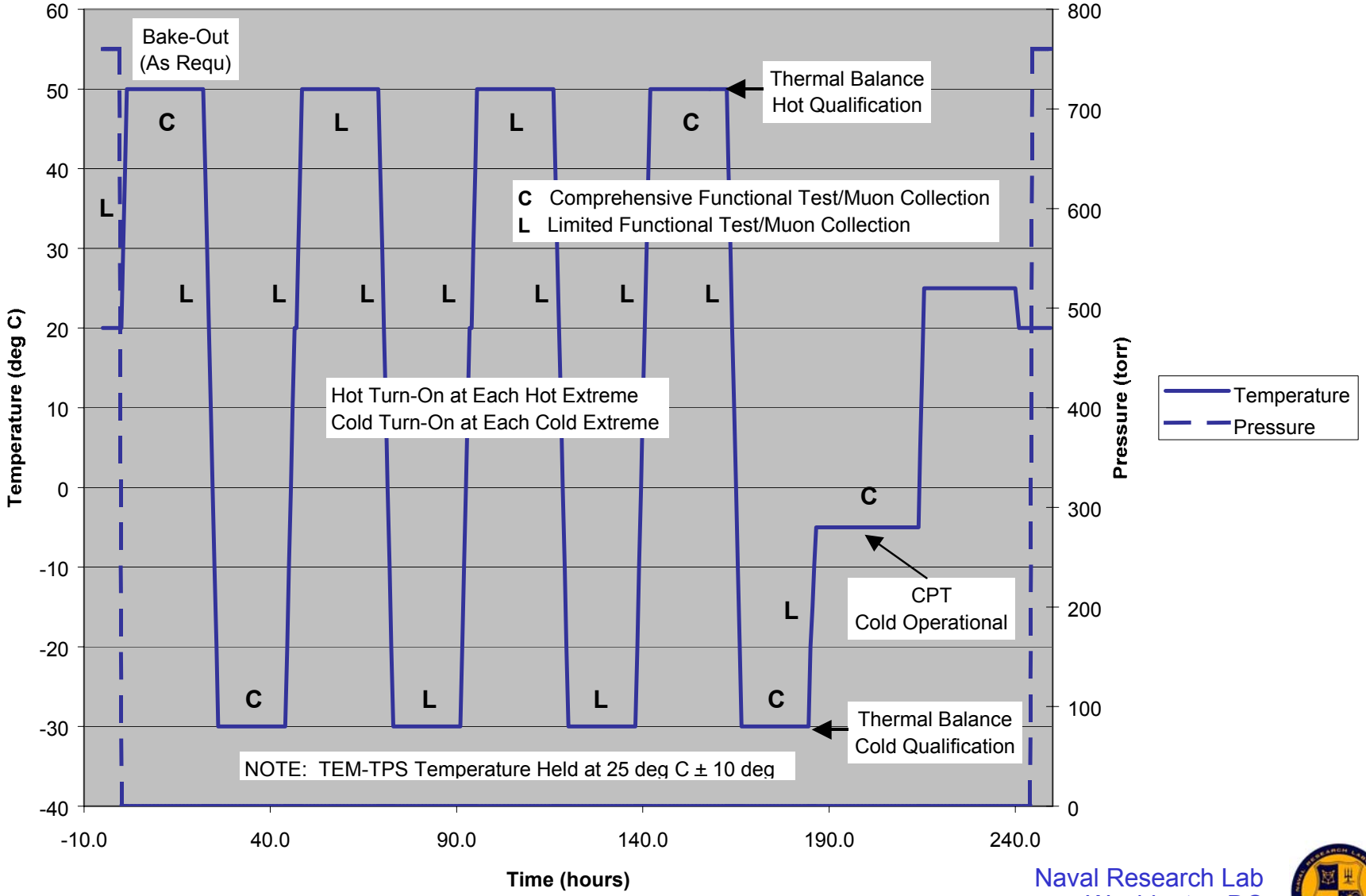
T-VAC Requirements and Traceability

- CAL module shall be capable of full operational performance over four thermal cycles at temperature extremes
  - *LAT Environmental Specification*, LAT-SS-00778

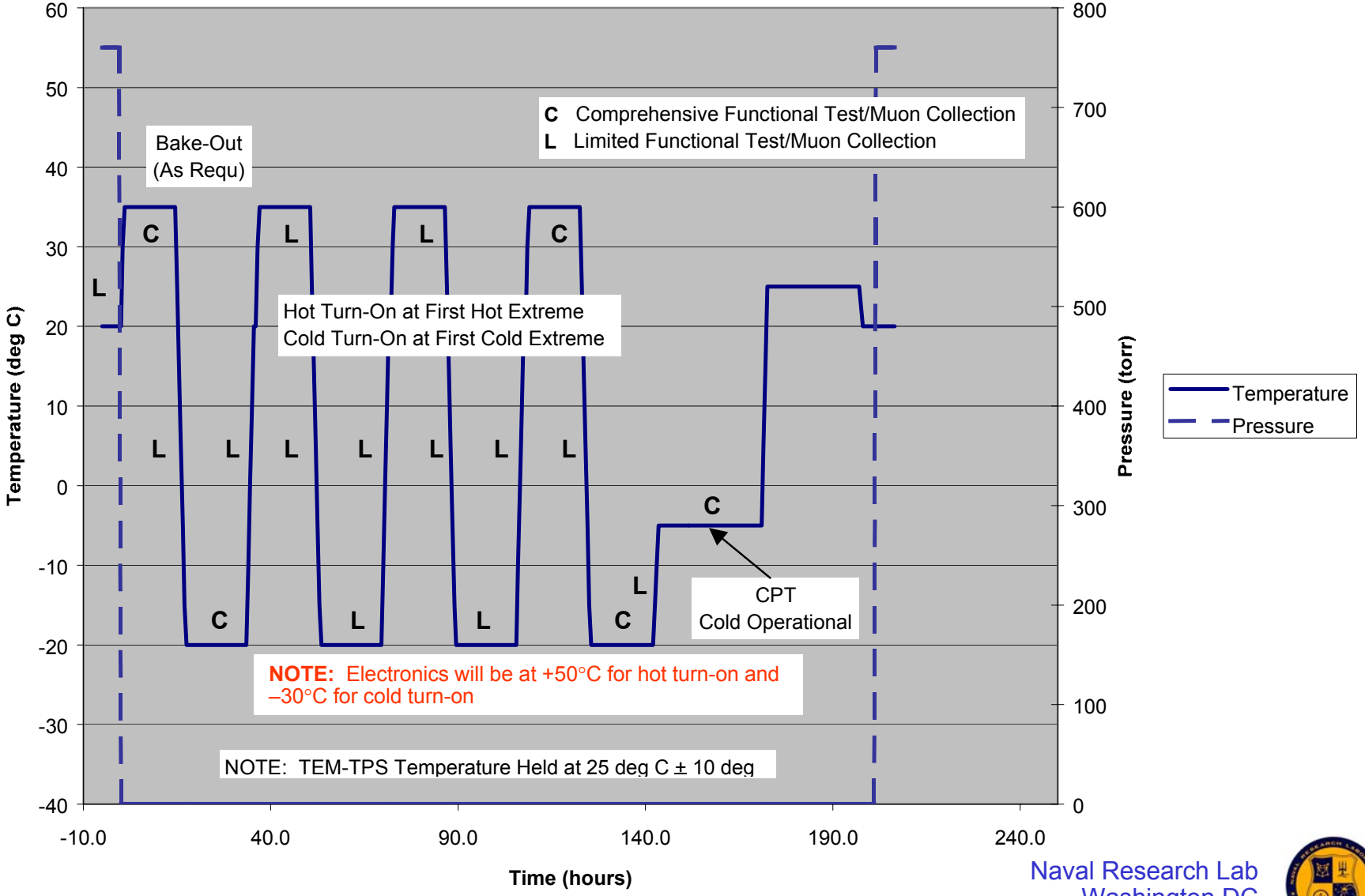
ENVIRONMENT	LAT-SS-00778	LEVELS TEST ARTICLE
Qualification Temperature	Table 30, Section 11.3	-30°C to +50°C (QM)
Acceptance Temperature	Table 30, Section 11.3	-20°C to +35°C (FM)
Operational Temperature	Table 30, Section 11.3	-5°C (QM and FM)

- Thermal balance test to demonstrate CAL thermal design

T-VAC Test Flow: Protoflight Test



T-VAC Test Flow: Acceptance Test



T-VAC Pass/Fail Criteria

- **CAL module must meet the following criteria to successfully complete the thermal-vacuum test requirements**
  - **Test levels are applied in accordance with…**
    - ***LAT Environmental Specification*, LAT-SS-00778, Section 11.3**
    - ***CAL Flight Module Thermal-Vacuum Test Procedure*, LAT-PS-04455, Sections 5.3.1, 5.3.2, and 6.1**
  - **No damage is incurred by the CAL module**
  - **Data is acquired and archived; suitable for correlation with thermal model**
  - **Successful post-test CAL functional testing and cosmic muon collection, in accordance with *CAL Comprehensive and Limited Performance Test Definition*, LAT-MD-01370**

T-VAC Testing to Date

Development Testing

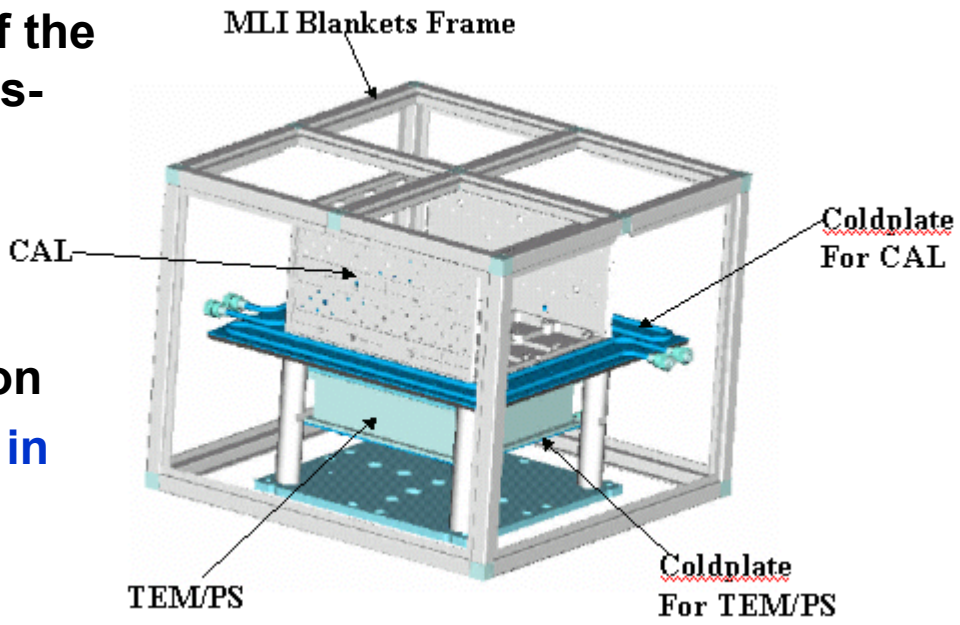
- **Developmental model CAL modules and CDEs successfully tested to beyond qualification levels**
  - LM2 & VM2 Performance Verification Plan (LAT-SS-00937) and Report (LAT-TD-00993)
- **EM CAL Module successfully testing to qualification levels**
  - CAL module Thermal-Vacuum Test Procedure (LAT-PS-01347)
  - Thermal Model Correlation (LAT-TD-02551)
  - CAL module EM Thermal-Vacuum and Thermal Balance Test Report (LAT-TD-04370)
  - Problem with EGSE version of TEM power supply at cold temperatures
- **Thermal balance test performed on EM CAL module**

T-VAC Testing to Date (cont.)

- **Component Testing (Thermal Cycle)**
  - **AFEE cards**
    - EEE Parts – all parts screened and approved
    - Burn-in (85°C) and 3-temperature testing (-30°C, +25°C, +55°C)
  - **CDE qualification and acceptance sampling includes thermal cycles**
    - CDE Qualification Plan (LAT-SS-02236-03): 60 cycles (-30°C to +60°C)
    - CDE Acceptance Plan (LAT-SS-02235-06): 25 cycles(-30°C to +60°C)

T-VAC Test Configuration

- The test specimen shall consist of the following, as documented in the as-built configuration list:
  - CAL Tower Module (LAT-DS-04536)
- Deviations from flight configuration
  - EM2 TEM-TPS assembly used in place of flight unit
  - Cold plate and heaters will maintain EM2 TEM/TPS temperature to +25°C ± 10°C
- Note that two modules will be tested at once with duplicate test fixtures in a single T-VAC chamber
  - FMA and FM18 will be tested alone

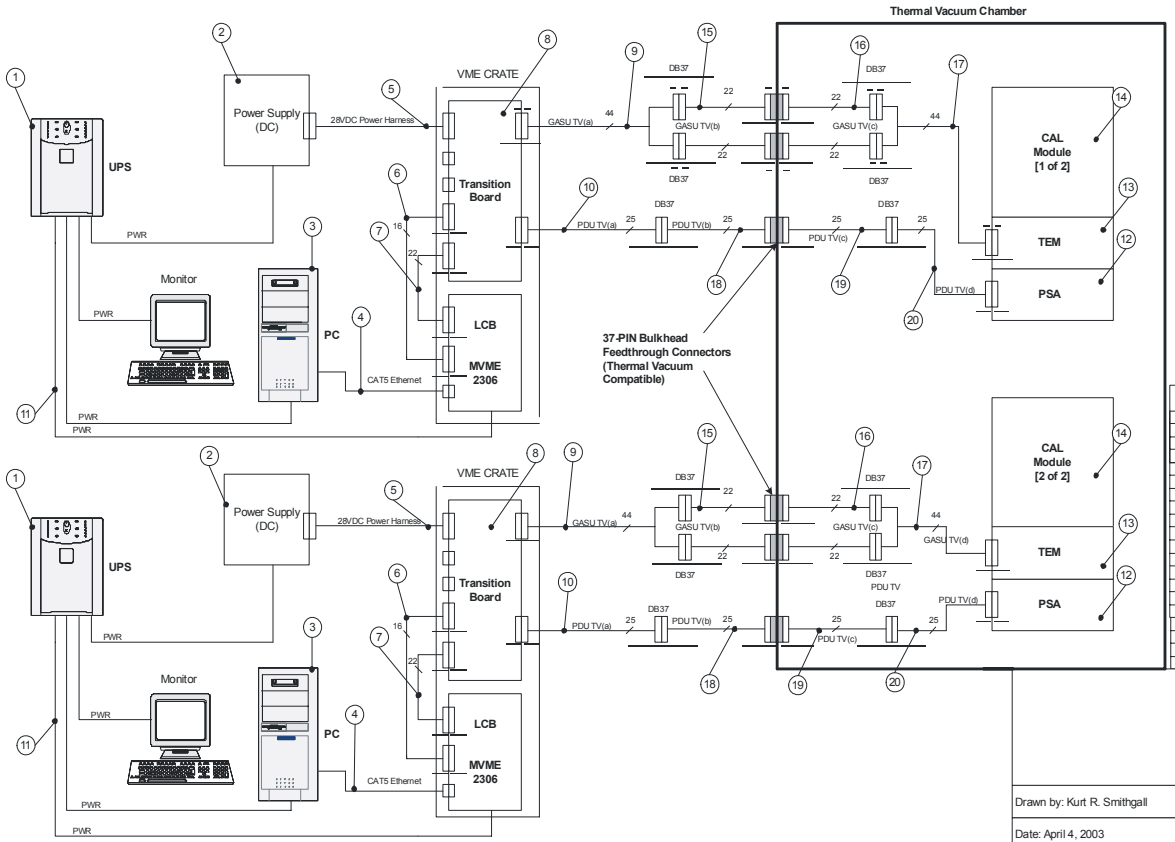


T-VAC EGSE Configuration

Notes:
1. LVDS harness length shall be limited to 10 meters (~32 feet), unless skew budget dictates shorter length
2. LVDS harness shall utilize twisted shielded pair; # TBD AWG
3. Ground and/or terminate unused conductors

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED

LAT-DS-01945-01



ITEM	QTY.	PART NO.	DESCRIPTION
1	2	SU1000RT2U	Tripp-Lite UPS 1000VA, 6 outlets, rackmount
2	2	BK1743A-ND	DC Power Supply; 0-35VDC, 0-6A Output
3	2	TBD	CPU & Monitor with ethernet card
4	2	TBD	CAT-5 Ethernet Cable
5	2	TBD	Power Supply to VME +28VDC Harness
6	2	TBD	Command Cable Harness
7	2	TBD	Event Cable Harness
8	2	TBD	VME Crate
9	2	LAT-DS-01946	GASU - TVAC Chamber Interface Cable
10	2	LAT-DS-01947	PDU - TVAC Chamber Interface Cable
11	8	TBD	120VAC Power Extension Cables
12	2	TBD	Power Supply Assembly (PSA)
13	2	TBD	Tower Electronics Module (TEM)
14	2 of 18	TBD	Calorimeter Module (CAL)
15	2	TBD2	External TVAC Pigtail
16	2	TBD3	Internal TVAC Pigtail
17	2	LAT-DS-01948	TVAC Chamber - TEM Interface Cable
18	2	TBD2	External TVAC Pigtail
19	2	TBD3	Internal TVAC Pigtail
20	2	LAT-DS-01949	TVAC Chamber - PSA Interface Cable

Gamma-ray Large Area Space Telescope

Thermal Vacuum Test Setup

Drawn by: Kurt R. Smithgall

Date: April 4, 2003

SIZE	FSCM NO	DWG NO	REV
		LAT-DS-01945	01
SCALE 1 : 1		SHEET 1 OF 1	

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T-VAC Test Flow

- **Thermal-Vacuum Cycle 1**
  - Bake-out
  - Hot and Cold turn-on
  - 4-hour test temperature soak: comprehensive performance test and muon collection
- **Thermal-Vacuum Cycle 2**
  - Hot and Cold turn-on (QM only)
  - 4 hour test temperature soak: limited performance test and muon collection
- **Thermal-Vacuum Cycle 3**
  - Hot and Cold turn-on (QM only)
  - 4-hour test temperature soak: limited performance test and muon collection
- **Thermal-Vacuum Cycle 4**
  - Hot and Cold turn-on (QM only)
  - 4-hour test temperature soak: comprehensive performance test and muon collection
  - Thermal balance test (QM only)
  - 4-hour operational temperature (-5°C) soak: comprehensive performance test and muon collection

T-VAC Facility Status

- **Facility will be ready by Sept. 17 (Oct. 1) test date**
  - Large thermal chamber, "Big Blue" — Modifications In Process
  - Medium thermal chamber, "North Chamber" — Modifications In Process
  - Temperature controller — Undergoing Test
  - Data acquisition system set-up — In Process
  - Thermocouples — Available
  - Power supplies — Available

- **Test fixture status**
  - Test stand — Available
  - Thermal blankets — Available
  - Heaters — Available
  - Cold plates — Delivery (Sept 15)

T-VAC Known Risks and Limitations

- **EM2 TEM/TPS has not been qualified at temperature**
  - **Temperature limits imposed by EM2 design do not meet test requirements**
  - **Test procedure controls EM2 TEM/TPS to +25°C ± 10°C**
- **Potential conflict with other flight programs for test facilities**
  - **Mitigated by use of one of two available chambers**

T-VAC Status

ITEM	STATUS
Requirements	Defined
Pass-Fail Criteria	Defined
Testing to Date	Successful (EGSE issue)
Configuration	Defined
Handling/Installation	Defined
Facility Status	In Process
Test Equipment	In Process
Risks and Limitations	Addressed
Procedure	Configured
Status	On Schedule